ORIGINAL ARTICLE

Self-rated hypertension and anthropometric indicators of body fat in elderly

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Abstract

Objective: To investigate the association between self-rated hypertension (sf-H) and anthropometric indicators of body and abdominal fat in elderly from the city of São Paulo. **Methods:** Data from 1894 elderly was obtained from the Survey on Aging, Health and Well-being (SABE). The anthropometric indicators used were: body mass index (BMI), waist circumference (WC), waist/hip ratio (WHR), and waist/height ratio (WHtR). Binary logistic regression analysis stratified by gender was used. **Results:** Hypertension was associated with anthropometric indicators. At the final model (adjusted for age, education, smoking status, physical activity, and diabetes) in both genders, BMI showed greater statistical power, although it has been similar to other indicators in females. Except for WHeR in males, sf-H was positively and independently associated with the other indicators. **Conclusion:** Results suggest the relevance of these indicators for early detection of the risk to develop hypertension and intervention in its prevention and management.

Keywords: Blood pressure; anthropometry; waist circumference; waist-hip ratio; body mass index.

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Introduction

High blood pressure is a major health problem all over the world[1]. In Brazil, the disease is estimated to affect 50% to 70% of elderly individuals[2]. One of the main risk factors associated with hypertension both in prospective studies[4] and cross-sectional studies[4-6] in different populations is excess body fat.

Regarding the association between hypertension and excess body fat, obesity is usually identified by body mass index (BMI)[6] and abdominal fat is identified by waist circumference (WC)[5,7], waist/hip ratio (WHR)[4] or waist/height ratio (WHtR)[8].

However, most studies checking the association between BMI and/or abdominal obesity indicators and hypertension occurrence were performed with adults[5,6,9] and only a few involved the elderly. However, these study results have been controversial, including with regard to gender[3,10], and they analyzed distinguished populations[10]. While some studies showed BMI[6] was the indicator more positively associated with hypertension, others suggested abdominal fat indicators were the most appropriate[4].

In the elderly, this relationship is understudied and the best anthropometric indicator to be used to check the association between hypertension and obesity has not been established yet.

This paper objective was to investigate the association between obesity indicators (BMI, WC, WHR, and WHtR) and presence of hypertension in elderly people from the city of São Paulo.

Methods

This is an association study based on data from the Survey on Aging, Health and Well-being (SABE), a multicenter, epidemiological, and home based survey performed in seven Latin American and Caribbean countries and it was coordinated by Pan American Health Organization[11]. In Brazil, the study was coordinated by professors of Universidade de São Paulo Public Health School and covered 2,143 elderly subjects (60 years) of both genders, habitual residents of São Paulo. Sampling procedures for SABE survey were previously described[12].

The Survey has been approved by the Ethics Committee and data were obtained through a two-step home interview; in the first step, an interviewer asked questions covering life conditions and health status, while the second step was performed by a couple of interviewers and covered anthropometry and motor performance tests. Data collection occurred from January 2000 to March 2001.

The study population comprised 1894 (88.4%) elderly. The elderly who did not participate in the second step due to refusal (7.5%), death (1.9%), change of address (2%), institutionalization (0.1%) and hospitalization (0,1%) was excluded.

Anthropometric variables (weight, height, waist and hip circumferences) were measured in triplicate in ambulatory elderly by nutritionists or graduation Nutrition students specifically trained for the study, and the mean values were used in the analysis.

Techniques and equipment used were previously described[13].

Self-rated hypertension (response or dependent variable) was checked by the question: "Has any doctor or nurse ever said you have high blood pressure, I mean, hypertension?" with a dichotomous choice for an answer (yes or no), corresponding to question C04 in SABE survey questionnaire (www.fsp.usp.br/sabe).

Anthropometric indicators (explanatory or independent variables) were: for body fat – body mass index (BMI = kg/m^2), calculated from body mass and height values, considering a hypertension risk when BMI 27 kg/m^2 [14]; for abdominal fat – waist circumference (WC), considering risk when 88 cm for females and 102 for males; waist/hip ratio (WHR), representing risk when 0.95 for males and 0.80 for females; and waist/height ratio (WHtR), considered as a hypertension risk when values > 0.50[16]. These variable required values were obtained from section K in the questionnaire (www.fsp.usp.br/sabe).

Confounding variables were age, regular physical activity practice (yes or no), smoking status (yes, former smoker, never smoker), diabetes (yes or no), education (low, middle, high).

Statistics

Mean values, standard deviation, and relative frequencies (%) were presented to describe explanatory variables according to gender. Continuous values were compared using t-test for independent samples. Frequency di® erences between categorical variables were assessed by the chi-square test.

Bynary logistic regression analysis stratified by gender was used to determine the association between anthropometric indicators (BMI, WC, WHR, WHtR) and hypertension. Explanatory variables with relevance to the study (BMI, WC, WHR, and WHtR) were assessed in the models as categorical (dichotomous) variables.

Three logistic regression models were proposed for each anthropometric indicator, with hypertension being a dependent (dichotomous) variable in all of them: 1) adjusted for age; 2) adjusted for age and education; 3) adjusted for age, education, smoking status, and regular physical activity (final model). In all models, the variable diabetes was additionally included (belonging to the causal chain) to assess how much the association could be explained by this covariate presence. Among the confounding variables, age entered the models as continuous variable. Education, smoking status, regular physical activity, and diabetes entered the models as categorical variables.

Every analysis was study design e® ect-weighted (post-stratification weight). Significance level of 5% (p £ 0.05) and 95% confidence interval (95% CI) were adopted and statistical so® ware SPSS® 15.0 was used for calculations.

Results

The study population comprised 1124 females (59.35%) and 770 males (40.65%), with ages ranging from 60 to 100, and the mean was 72.88 ± 8.39 (standard deviation) for females and 73.77 ± 8.49 for males.

Table 1 shows the study population distribution according to gender and analyzed variables. Statistical differences were observed between genders in all variables except for diabetes and WHtR. The highest frequency of smoking and physical activity practice were observed among males, while, in females, there was higher prevalence for BMI, WC, WHR, low education, and hypertension.

Analysis of the relationship between hypertension and body (BMI) and abdominal (WC, WHR, and WHtR) fat indicators according to gender and adjusted for age showed that all indicators presented an association with hypertension in both genders, except for WHtR in males. Additional adjustment for diabetes contributed to reduce the magnitude in all associations, but it did not change their meaning. For males, BMI was the indicator most strongly associated with hypertension. For females, all the indicators were similarly associated. In this model, the likelihood of hypertension in males with a BMI value indicating obesity was 93% higher than in those men whose BMI did not indicate obesity. For females, the association was nearly twofold higher in women showing BMI, WC, WHR or WHrT values indicating body or abdominal obesity (Table 2, model 1).

When education and diabetes were included in the regression model (Table 2, model 2), the association between hypertension and anthropometric indicators of abdominal fat according to gender did not present any change in associations, as they showed to be similar to the previous model, adjusted only for age.

The inclusion of smoking status and regular physical activity practice in the age- and education-adjusted model contributed significantly to reduce the association magnitude, except for BMI in females and WHR in both

Table 1 – Distribution of elderly from São Paulo according to gender and study variables (SABE-SP, 2000)

Study variables	Gender				p
	Male		Female		
	AF	RF	AF	RL	
Body mass index					
No risk	531	72.2	589	55.1	0.001
Risk	204	27.8	479	44.9	
Waist circumference					
No risk	324	43.9	173	16.1	
Risk	414	56.1	901	83.9	0.001
Waist/hip ratio					
No risk	493	66.9	152	14.2	
Risk	244	33.1	921	85.8	0.001
Waist/height ratio					
No risk	87	11.9	115	10.8	
Risk	647	88.1	951	82.9	0.482
Education					
Low	139	18.2	266	24	
Middle	497	65.2	736	66.4	
High	126	16.5	106	9.6	0.001
Smoking status					
Yes	177	23.1	124	11.2	
Former smoker	391	51.0	197	17.7	
No	198	25.8	791	71.1	0.001
Physical activity					
Yes	227	29.7	267	24	
No	537	70.3	846	76	0.006
Diabetes					
Yes	122	16.2	214	19.3	
No	632	83.8	895	80.7	0.086
Arterial hypertension					
Yes	363	47.8	639	57.6	
No	397	52.2	470	42.4	0.001

AF, absolute frequency; RF, relative frequency (%).

genders (Table 3). The final model, adjusted for diabetes, showed BMI was the indicator associated with greater statistical power to hypertension in the elderly of both sexes, although being similar to other indicators in females. In this model, the likelihood of hypertension development in elderly with BMI 27 kg/m^2, which was considered a risk factor, is 85% higher in males and 2.18 times higher in females, compared to those whose BMI value was < 27 kg/m^2, which was considered risk-free.

Discussion

This is the first population- and home-based study checking the association between hypertension and (body and abdominal) fat anthropometric indicators in Brazilian elderly. The study had an elderly population representative sample from the city of São Paulo, with data being collected by interviewers specifically trained for the SABE survey.

In this study, (body and abdominal) fat anthropometric indicators showed an association with hypertension, corroborating the results of other studies performed with subjects from different populations and age groups, with excess fat being considered, regardless the anthropometric indicator used, one of the major risk factors for hypertension, and with abdominal fat being considered an additional predictive factor to hypertension development[3,6,17]. This fact probably can be explained by physiological changes occurring in obese subjects, such as a sympathetic nervous system and/or renin-angiotensin-aldosterone system activation and/or endothelial dysfunction and function abnormalities[18].

This study's results showed the association between hypertension and anthropometric indicators had a few differences, according to the gender. For males, the association between WHtR and the disease was not observed, whereas BMI was the indicator most strongly associated with hypertension. For females, all indicators were similarly associated with hypertension.

BMI is the indicator most often used in epidemiological studies[2,6,8,19,20], including elderly studies, even though there is no consensus on the more appropriate criteria/values to define obesity in that age group. In addition, many authors[16,21] have suggested BMI is not sufficient as an indicator to identify the association between body fat and non-transmitted chronic diseases (NTCDs), such as arterial hypertension. It is also necessary to assess the location of fat, whose presence in visceral region is indicative of NTCD risk.

Table 2 – Association between hypertension and anthropometric indicators of body and abdominal fat according to gender, adjusted for age (model 1) and age and education (model 2) (SABE-SP, 2000)

Anthropometric Indicators	Model 1						Model 2					
	Male			Female			Male			Female		
	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p	OR	95% CI	p
BMI	1.97	1.42-2.74	0.001	2.18	1.69-2.81	0.001	1.97	1.41-2.74	0.001	2.22	1.72-2.86	0.001
BMI*	1.93	1.38-2.70	0.001	2.14	1.65-2.77	0.001	1.91	1.33-2.68	0.001	2.16	1.67-2.81	0.001
WC	1.49	1.12-2.00	0.008	2.34	1.67-3.27	0.001	1.50	1.11-2.02	0.008	2.33	1.66-3.26	0.001
WC*	1.45	1.08-1.96	0.014	2.10	1.49-2.96	0.001	1.46	1.08-1.97	0.014	2.10	1.49-2.96	0.001
WHR	1.61	1.18-2.20	0.002	2.43	1.71-3.47	0.001	1.64	1.20-2.24	0.002	2.37	1.66-3.38	0.001
WHR*	1.55	1.13-2.12	0.006	2.18	1.52-3.12	0.001	1.57	1.14-2.15	0.006	2.13	1.48-3.06	0.001
WHtR	1.30	0.83-2.05	0.256	2.43	1.62-3.14	0.001	1.39	0.87-2.21	0.166	2.39	1.59-3.59	0.001
WHtR*	1.29	0.81-2.04	0.283	2.20	1.46-3.32	0.001	1.39	0.87-2.22	0.169	2.18	1.44-3.29	0.001

OR, odds ratio; *, also adjusted for diabetes.

Table 3 – Association between hypertension and anthropometric indicators of body and abdominal fat according to gender, adjusted for age, Education, smoking status, and physical activity (SABE-SP, 2000)

Anthropometric indicators	Gender					
	Male			Female		
	OR	95% CI	p	OR	95% CI	p
BMI	1.90	1.36-2.66	0.001	2.18	1.68-2.83	0.001
BMI*	1.85	1.31-2.60	0.001	2.15	1.65-2.81	0.001
WC	1.44	1.06-1.94	0.018	2.15	1.53-3.03	0.001
WC*	1.40	1.03-1.90	0.032	1.98	1.40-2.81	0.001
WHR	1.64	1.20-2.25	0.002	2.31	1.61-3.32	0.001
WHR*	1.57	1.14-2.16	0.006	2.10	1.46-3.04	0.001
WHtR	1.28	0.79-2.06	0.311	2.26	1.50-3.41	0.001
WHtR*	1.28	0.79-2.08	0.311	2.10	1.38-3.18	0.001

OR, odds ratio; *, also adjusted for diabetes.

However, different abdominal fat indicators seem to indicate different risks. According to Björntorp[21], the WC is the most appropriate indicator identifying visceral fat accumulation, being strongly associated with atherosclerotic cardiovascular diseases, while WHR, considering the gluteus measurement, with this area having a lot of major muscle tissues regulating systemic insulin sensitivity, would be more strongly associated with insulin resistance.

WHtR is an indicator proposed in the mid-90s[16], and its influence on NTCD risk is not quite established, thus, further studies are still required, including the elderly population.

Few studies investigating the relationship between different (body and/or abdominal) fat indicators and hypertension were found in literature and results were not consistent. In a cross-sectional Polish study (70 years old), excess body fat, identified as BMI 30 kg/m^2, was found to be associated with hypertension, albeit differently in both genders, predominating in females[22]. Renón *et al.*[3], in Spain, studied 6262 subjects (60 years old), with BMI (25 kg/m^2) and WC (88 cm for females and 102 cm for males) impact on hypertension prevalence being observed as direct and independent. The probable association of BMI (25 kg/m^2 and 30 kg/m^2) with disease development, according to the odds ratio, was higher in both genders and WC was higher in females.

A cohort 10-year study[9] in two Japanese communities with the subjects' age ranging from 45 to 69 years showed BMI and WC values in the third tertile of distribution were positively associated with hypertension risk in both genders in one of the communities, but only in females in the other community. The association between WHtR and hypertension has not been found either in that population or in men in this current study.

By considering several study data, the anthropometric indicators strength of association for hypertension development is found to be different regarding either age groups or geographical regions/countries.

Diabetes is a morbidity often associated with hypertension, and this study's results showed that its inclusion in all regression models did not change significantly the association between the dependent variable and independent explanatory variables, although it has contributed to reduce the strength of association, as observed by Barbosa *et al.*[10] in their elderly study in Barbados and Cuba.

In the present study, adjustment for education, did not change the associations direction, however, the inclusion of smoking and benefits of regular physical activity reduced the associations magnitude, except for BMI in female and WHR in both genders, as evidenced by Barbosa *et al.*[10].

While education is considered a socioeconomic factor determining health status, mostly because it has an impact on the subject's occupation and income, this variable seems to exert minor effect on health over old age vital stage.

The relationship between arterial hypertension and smoking is not entirely clear. Recent prospective studies suggest smoking might be a minor risk factor for the development of hypertension[23], although it may have some effect on the subject's body weight[24].

The regular physical activity practice has been proposed as a strategy in preventing and controlling hypertension, as well as in treating hypertensive subjects, thus contributing to reduce or minimize other cardiovascular disease risk factors, such as reduced body fat[25].

In a study involving men (9,963) and women (12,154) age 45-79 years, the indicators WHR, BMI and WC were similarly associated with hypertension. When the analysis was adjusted for other variables (age, BMI, WHR, WC, smoking status, social status, drinking status and physical activity practice), WHR and BMI association with hypertension remained independent for both genders, whereas WC remained significantly independent only for women[4].

In the current study, the final model (adjusted additionally for diabetes) showed BMI is the indicator with higher statistical power of association with hypertension in the elderly of both genders, though it is quite similar to other indicators in females.

The study cross-sectional design does not allow establishing a cause-effect relationship between obesity and hypertension. Another limitation concerns the use of reported information about the presence of hypertension. Some studies show this kind of information has good concordance, compared to medical records or clinical evaluations[26-27], being widely used for understanding certain population conditions and evaluate health policies[28]. Self-rated morbidity could lead to underestimating a chronic condition prevalence, since it allows for identification of subjects with a previous diagnosis, but may omit those who had never been given a diagnosis that could indicate the presence or absence of hypertension.

Conclusion

In conclusion, self-rated hypertension was found to be positively associated with (body and abdominal) fat anthropometric indicators used in the current study, with BMI being the indicator with higher statistical power in both genders, although it was found to be similar to the other indicators in women. Except for WHtR, the other indicators were positive and independently associated with self-rated hypertension in men.

The results obtained show the relevance of these indicators in identifying arterial hypertension risk and the importance of adopting them in clinical practice and/or epidemiological studies in elderly and younger adults, considering the use of anthropometric variables whose cost, practicality, and reliability are competitive and/or more advantageous than other methods. These indicators can contribute to early identification of hypertension risk, enabling prevention and management actions and strategies.

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